Practitioner's Docket No. 2497/102

CHAPTER II

Preliminary Classification:

Proposed Class:

Subclass:

NOTE: "All applicants are requested to include a preliminary classification on newly filed patent applications. The preliminary classification, preferably class and subclass designations, should be identified in the upper right-hand corner of the letter of transmittal accompanying the application papers, for example 'Proposed Class 2, subclass 129.'" M.P.E.P., § 601, 7th ed.

TRANSMITTAL LETTER TO THE UNITED STATES ELECTED OFFICE (EO/US)

(ENTRY INTO U.S. NATIONAL PHASE UNDER CHAPTER II)

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/GB99/01964	22 June 1999	22 June 1998

TITLE OF INVENTION

Anti-Collision Tag Apparatus and System

APPLICANT(S)

Powell

Box PCT
Assistant Commissioner for Patents
Washington D.C. 20231

ATTENTION: EO/US

CERTIFICATION UNDER 37 C.F.R. § 1.10*
(Express Mail label number is mandatory.)
(Express Mail certification is optional.)

I hereby certify that this Transmittal Letter and the papers indicated as being transmitted therewith is being deposited with the United States Postal Service on this date 18 December 2000, in an envelope as "Express Mail Post Office to Addressee" Mailing Label Number EL502340969 US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Timothy M. Murphy

(type or print name of person mailing paper)

Signature of person mailing paper

WARNING: *Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. § 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.*

***WARNING:** Each paper or fee filed by "Express Mail" **must** have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. § 1.10(b).*
*"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.*

NOTE: To avoid abandonment of the application, the applicant shall furnish to the USPTO, not later than 20 months from the priority date: (1) a copy of the international application, unless it has been previously communicated by the International Bureau or unless it was originally filed in the USPTO; and (2) the basic national fee (see 37 C.F.R. § 1.492(a)). The 30-month time limit may not be extended 37 C.F.R. § 1.495.

WARNING: *Where the items are those which can be submitted to complete the entry of the international application into the national phase are subsequent to 30 months from the priority date the application is still considered to be in the international state and if mailing procedures are utilized to obtain a date the express mail procedure of 37 C.F.R. § 1.10 must be used (since international application papers are not covered by an ordinary certificate of mailing—See 37 C.F.R. § 1.8.*

NOTE: Documents and fees must be clearly identified as a submission to enter the national state under 35 U.S.C. § 371 otherwise the submission will be considered as being made under 35 U.S.C. § 111. 37 C.F.R. § 1.494(f).

I. Applicant herewith submits to the United States Elected Office (EO/US) the following items under 35 U.S.C. § 371:

a. ☒ This express request to immediately begin national examination procedures (35 U.S.C. § 371(f)).

b. ☒ The U.S. National Fee (35 U.S.C. § 371(c)(1)) and other fees (37 C.F.R. § 1.492) as indicated below:

2. Fees

CLAIMS FEE	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
☒*	TOTAL CLAIMS 23	−20=	3	× $18.00=	$ 54.00
	INDEPENDENT CLAIMS 3	−3=	0	× ~~$78.00~~=	0
	MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ ~~$260.00~~	
BASIC FEE**	☐ U.S. PTO WAS INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY Where an international preliminary examination fee as set forth in § 1.482 has been paid on the international application to the U.S. PTO: ☐ and the international preliminary examination report states that the criteria of novelty, inventive step (non-obviousness) and industrial activity, as defined in PCT Article 33(1) to (4) have been satisfied for all the claims presented in the application entering the national stage (37 C.F.R. § 1.492(a)(4)) ..... $96.00 ☐ and the above requirements are not met (37 C.F.R. § 1.492(a)(1)) ..... $670.00 ☐ U.S. PTO WAS NOT INTERNATIONAL PRELIMINARY EXAMINATION AUTHORITY Where no international preliminary examination fee as set forth in § 1.482 has been paid to the U.S. PTO, and payment of an international search fee as set forth in § 1.445(a)(2) to the U.S. PTO: ☐ has been paid (37 C.F.R. § 1.492(a)(2)) ..... $690.00 ☐ has not been paid (37 C.F.R. § 1.492(a)(3)) ..... $970.00 ☒ where a search report on the international application has been prepared by the European Patent Office or the Japanese Patent Office (37 C.F.R. § 1.492(a)(5)) ..... ~~$946.00~~				860.00
	Total of above Calculations				=
SMALL ENTITY	Reduction by 1/2 for filing by small entity, if applicable. Affidavit must be filed also. (note 37 C.F.R. § 1.9, 1.27, 1.28)				–
	Subtotal				914.00
	Total National Fee				$ 914.00
	Fee for recording the enclosed assignment document $40.00 (37 C.F.R. § 1.21(h)). (See Item 13 below). See attached "ASSIGNMENT COVER SHEET".				
TOTAL	Total Fees enclosed				$ 914.00

*See attached Preliminary Amendment Reducing the Number of Claims.

i. ☒ A check in the amount of 914.00 to cover the above fees is enclosed.

ii. ☐ Please charge Account No. _____ in the amount of $ _____. A duplicate copy of this sheet is enclosed.

***WARNING:** *"To avoid abandonment of the application the applicant shall furnish to the United States Patent and Trademark Office not later than the expiration of 30 months from the priority date: * * * (2) the basic national fee (see § 1.492(a)). The 30-month time limit may not be extended." 37 C.F.R. § 1.495(b).*

WARNING: *If the translation of the international application and/or the oath or declaration have not been submitted by the applicant within thirty (30) months from the priority date, such requirements may be met within a time period set by the Office. 37 C.F.R. § 1.495(b)(2). The payment of the surcharge set forth in § 1.492(e) is required as a condition for accepting the oath or declaration later than thirty (30) months after the priority date. The payment of the processing fee set forth in § 1.492(f) is required for acceptance of an English translation later than thirty (30) months after the priority date. Failure to comply with these requirements will result in abandonment of the application. The provisions of § 1.136 apply to the period which is set. Notice of Jan. 3, 1993, 1147 O.G. 29 to 40.*

3. ☒ A copy of the International application as filed (35 U.S.C. § 371(c)(2)):

NOTE: Section 1.495 (b) was amended to require that the basic national fee and a copy of the international application must be filed with the Office by 30 months from the priority date to avoid abandonment. "The International Bureau normally provides the copy of the international application to the Office in accordance with PCT Article 20. At the same time, the International Bureau notifies applicant of the communication to the Office. In accordance with PCT Rule 47.1, that notice shall be accepted by all designated offices as conclusive evidence that the communication has duly taken place. Thus, if the applicant desires to enter the national stage, the applicant normally need only check to be sure the notice from the International Bureau has been received and then pay the basic national fee by 30 months from the priority date." Notice of Jan. 7, 1993, 1147 O.G. 29 to 40, at 35-36. See item 14c below.

a. ☐ is transmitted herewith.

b. ☐ is not required, as the application was filed with the United States Receiving Office.

c. ☒ has been transmitted

i. ☒ by the International Bureau.
Date of mailing of the application (from form PCT/1B/308): 29/12/99

ii. ☐ by applicant on _____.
Date

4. ☒ A translation of the International application into the English language (35 U.S.C. § 371(c)(2)):

a. ☐ is transmitted herewith.

b. ☒ is not required as the application was filed in English.

c. ☐ was previously transmitted by applicant on _____
Date

d. ☐ will follow.

5. ☒ Amendments to the claims of the International application under PCT Article 19 (35 U.S.C. § 371(c)(3)):

NOTE: The Notice of January 7, 1993 points out that 37 C.F.R. § 1.495(a) was amended to clarify the existing and continuing practice that PCT Article 19 amendments must be submitted by 30 months from the priority date and this deadline may not be extended. The Notice further advises that: "The failure to do so will not result in loss of the subject matter of the PCT Article 19 amendments. Applicant may submit that subject matter in a preliminary amendment filed under section 1.121. In many cases, filing an amendment under section 1.121 is preferable since grammatical or idiomatic errors may be corrected." 1147 O.G. 29-40, at 36.

a. ☐ are transmitted herewith.

b. ☒ have been transmitted

i. ☐ by the International Bureau.
Date of mailing of the amendment (from form PCT/1B/308): _____.

ii. ☒ by applicant on (date) 24/05/00 (Date)

c. ☐ have not been transmitted as

i. ☐ applicant chose not to make amendments under PCT Article 19.
Date of mailing of Search Report (from form PCT/ISA/210.): _____.

ii. ☐ the time limit for the submission of amendments has not yet expired. The amendments or a statement that amendments have not been made will be transmitted before the expiration of the time limit under PCT Rule 46.1.

6. ☒ A translation of the amendments to the claims under PCT Article 19 (38 U.S.C. § 371(c)(3)):

a. ☐ is transmitted herewith.

b. ☒ is not required as the amendments were made in the English language.

c. ☐ has not been transmitted for reasons indicated at point 5(c) above.

7. ☒ A copy of the international examination report (PCT/IPEA/409)

☒ is transmitted herewith.

☐ is not required as the application was filed with the United States Receiving Office.

8. ☒ Annex(es) to the international preliminary examination report

a. ☒ is/are transmitted herewith.

b. ☐ is/are not required as the application was filed with the United States Receiving Office.

9. ☒ A translation of the annexes to the international preliminary examination report

a. ☐ is transmitted herewith.

b. ☒ is not required as the annexes are in the English language.

10. ☒ An oath or declaration of the inventor (35 U.S.C. § 371(c)(4)) complying with 35 U.S.C. § 115

a. ☐ was previously submitted by applicant on _____
Date

b. ☐ is submitted herewith, and such oath or declaration

i. ☐ is attached to the application.

ii. ☐ identifies the application and any amendments under PCT Article 19 that were transmitted as stated in points 3(b) or 3(c) and 5(b); and states that they were reviewed by the inventor as required by 37 C.F.R. § 1.70.

c. ☒ will follow.

II. Other document(s) or information included:

11. ☒ An International Search Report (PCT/ISA/210) or Declaration under PCT Article 17(2)(a):

a. ☒ is transmitted herewith.

b. ☐ has been transmitted by the International Bureau.
Date of mailing (from form PCT/IB/308): _____.

c. ☐ is not required, as the application was searched by the United States International Searching Authority.

d. ☐ will be transmitted promptly upon request.

e. ☐ has been submitted by applicant on _____.
Date

12. ☒ An Information Disclosure Statement under 37 C.F.R. §§ 1.97 and 1.98:

a. ☐ is transmitted herewith.

Also transmitted herewith is/are:

☐ Form PTO-1449 (PTO/SB/08A and 08B).

☐ Copies of citations listed.

b. ☒ will be transmitted within THREE MONTHS of the date of submission of requirements under 35 U.S.C. § 371(c).

c. ☐ was previously submitted by applicant on _____.
Date

13. ☐ An assignment document is transmitted herewith for recording.

A separate ☐ "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or ☐ FORM PTO 1595 is also attached.

_____

_____

_____

14. ☒ Additional documents:
   a. ☐ Copy of request (PCT/RO/101)
   b. ☒ International Publication No. WO99/67735
      i. ☒ Specification, claims and drawing
      ii. ☐ Front page only
   c. ☒ Preliminary amendment (37 C.F.R. § 1.121)
   d. ☐ Other

15. ☒ The above checked items are being transmitted
   a. ☒ before 30 months from any claimed priority date.
   b. ☐ after 30 months.

16. ☐ Certain requirements under 35 U.S.C. § 371 were previously submitted by the applicant on ____________, namely:

AUTHORIZATION TO CHARGE ADDITIONAL FEES

WARNING: *Accurately count claims, especially multiple dependant claims, to avoid unexpected high charges if extra claims are authorized.*

NOTE: "A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).

NOTE: "Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).

☒ The Commissioner is hereby authorized to charge the following additional fees that may be required by this paper and during the entire pendency of this application to Account No. 19-4972.

☒ 37 C.F.R. § 1.492(a)(1), (2), (3), and (4) (filing fees)

WARNING: *Because failure to pay the national fee within 30 months without extension (37 C.F.R. § 1.495(b)(2)) results in abandonment of the application, it would be best to always check the above box.*

☒ 37 C.F.R. § 1.492(b), (c) and (d) (presentation of extra claims)

NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 C.F.R. § 1.492(d)). It might be best not to authorize the PTO to charge additional claim fees, except possible when dealing with amendments after final action.

☐ 37 C.F.R. § 1.17 (application processing fees)

☐ 37 C.F.R. § 1.17(a)(1)–(5) (extension fees pursuant to § 1.136(a).

☐ 37 C.F.R. § 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. § 1.311(b))

NOTE: Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 C.F.R. § 1.311(b).

NOTE: 37 C.F.R. § 1.28(b) requires "Notification of any change in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying . . . issue fee." From the wording of 37 C.F.R. § 1.28(b): (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

☐ 37 C.F.R. § 1.492(e) and (f) (surcharge fees for filing the declaration and/or filing an English translation of an International Application later than 30 months after the priority date).

SIGNATURE OF PRACTITIONER

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02101
PATENT TRADEMARK OFFICE

Timothy M. Murphy
(type or print name of practitioner)

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Boston, MA 02110

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Powell et al. Attorney Docket: 2497/102

International Application No: PCT/GB99/01964 International Filing Date: June 22, 1999

Invention: ANTI-COLLISION TAG APPARATUS AND SYSTEM

CERTIFICATE OF MAILING

I hereby certify that the following document is being transmitted via Express Mail EL502340969US to the Commissioner for Patents, Box PCT, Washington, DC 20231, Attention: EO/US on December 18, 2000.

Timothy M. Murphy

Commissioner for Patents
Box PCT
Washington, D.C. 20231
Attn: EO/US

PRELIMINARY AMENDMENT

Dear Sir:

The applicants submit this preliminary amendment in connection with entering the national phase for the above-referenced international patent application. Please enter the following amendment to the national stage application.

In the Description

On page 1, after "ANTI-COLLISION TAG APPARATUS AND SYSTEM" please insert --This application claims priority from United Kingdom patent application serial number 9813371.3, filed June 22, 1998.--

In the Claims

Please amend claims 1, 4-8, and 10-16, and add new claims 17-23.

1. (Amended) A radio frequency tag identification system comprising a plurality of tags and a transceiver for sending information to and [simultaneously] receiving information from [a plurality of] the tags [without corruption], wherein each tag is allocated an identification word comprising a predetermined number of bits, the tags comprising means for selectively modulating a signal received from the transceiver, and the transceiver comprising means for sending an interrogation signal comprising a plurality of portions, wherein each portion is associated with a predetermined bit, or bit sequence, of the identification words and is used to simultaneously interrogate the tags [and simultaneously receive information from tags to identify] to identify, in response to modulated signals provided by the tags, the presence of a tag or tags having a given value at the predetermined bit or bit sequence.

4. (Amended) A system as claimed in [any of the preceding claims] claim 1, including in each tag an inductive loop antennae or capacitor plates that will convert the electric power into an electric field to communicate with transponders and provide the power for transponders where this power is not derived internally within the transponder from internal batteries or a light cell.

5. (Amended) A system as claimed in [any of the preceding claims] claim 1, including in each tag an antenna that will convert the signal power from the transceiver into an RF field to communicate with transponders.

6. (Amended) A system as claimed in [any of the preceding claims] claim 1, the transceiver including means for determining the nature of the modulation based on the logical outcome of previous communications with tags to conduct a binary search.

7. (Amended) A system as claimed in [any of the preceding claims] claim 1, the transceiver including means for detecting the modulation impressed on the field by any tag [or plurality of tags in simultaneous communication, without corruption,] comprising a demodulator and an amplifier, wherein the modulation signal is sent to a processor in a logic block and is digitized within a logic processor and evaluated.

8. (Amended) A system as claimed in [any of the preceding claims] claim 1, the tag or tags comprising signal pickup means, a rectifier, a limiter with hysteresis, a clock extractor, a data extractor, a modulator and a logic section.

10. (Amended) A method of detecting the presence of tags within a target area by sending interrogation signals from a transceiver for selective [simultaneous] modulation by [active] tags present in the target area, each tag being allocated an identification word comprising a predetermined number of bits, the method comprising:

sending from a transceiver an interrogation signal comprising a plurality of portions, each portion being associated with a predetermined bit or bit sequence of the identification words and being capable of conveying a given value for the bit or sequence of bits, [each portion being determined by the transceiver in dependence on the modulation response to the previous portion,] wherein [all] tags [in the field] having the value at the predetermined bit or bit sequence are configured to [simultaneously] modulate the signal, the modulation being used to identify the presence of those tags.

11. (Amended) A method as claimed in claim 10, wherein the presence of a tag or tags having an individual identification word is detected by sending an interrogation signal having portions [and] corresponding to all bits of the identification words.

12. (Amended) A method as claimed in claim 10 [or 11, using an adaptive interrogation signal], wherein each portion comprises a first part which is used to [simultaneously] interrogate [all active] the tags to determine whether in a tag or a plurality of tags the associated bit or sequence of bits has a first value, and a second part which is [determined in dependence on the simultaneous response of the active tags in the field] used to interrogate the tags to determine whether the associated bit or sequence of bits has a second value.

13. (Amended) A method as claimed in claim 12, wherein if a portion is used to interrogate the tags to determine whether in a tag or a plurality of tags the associated bit or sequence of bits having the first value, the first part is sent, and if the portion is used to interrogate the tags to determine whether the

associated bit or sequence of bits has a second value, the first and second parts are sent.

14. (Amended) A method as claimed in claim 10 [to 13], wherein a tag not having the value at the predetermined bit or bit sequence ignores further signals until an activation or a wake signal is received.

15. (Amended) A method as claimed in [any one of claims] claim 10 [to 14], wherein data bits of a tag transponder are read from and /or written to by sending further bits after the interrogation signal, wherein tag then deactivates and ignores further signals until an activation signal is received.

16. (Amended) A method as claimed in claim 10, whereby a tag can determine if the reader transceiver has received its attempted communication based on subsequent interrogation signals.

17. (New) A method as claimed in claim 13, wherein only if there is no response to the first part is the second part sent.

18. (New) A method of identifying tags within a target area using a communication signal of a substantially continuous first duration representing a first value or of a substantially continuous extended duration representing a second value, each tag being allocated an identification word comprising a predetermined number of bits, for each bit of the identification word, the method comprising the steps of:

(a) transmitting from a transmitter a first communication signal;

(b) receiving the signal at a tag and, if the identification word of the tag has the value at the respective bit and if the tag is not deactivated, modulating the signal at the tag;

(c) monitoring at the transmitter the signal for modulation and,

(c1) if modulation is detected, recording the presence of at least one tag having the first value at the respective bit, not transmitting the communication signal for the extended duration and proceeding to step (f);

(c2) if no modulation is detected during the first duration, continuing the transmission of the first communication signal for the extended duration;

(d) receiving the signal at a tag during the extended duration and, if the identification word of the tag has the second value at the respective bit and if the tag is not deactivated, modulating the signal at the tag;

(e) monitoring at the transmitter the communication signal for modulation and,

(e1) if modulation is detected during the extended duration, recording the presence of at least one tag having the second value at the respective bit and proceeding to step (g);

(e2) if no modulation is detected during the extended duration, indicating that no tag is present in the target area;

(f) deactivating tags having the second value at the respective bit which do not receive an extended communication signal; and

(g) if a communication signal for each bit of the identification word has been transmitted, indicating the presence of a tag having an identification word corresponding to the combination of recorded bit values, otherwise proceeding to step (a) for the next bit.

19. (New) A method according to claim 18, further comprising the step of transmitting a reactivation signal from the transmitter, tags having been deactivated in step (f) receiving the signal reactivating themselves to thereby receive further communication signals.

20. (New) A method according to claim 18, whereby a tag having each bit of its identification word transmitted is configured to accept read/write commands, the method further comprising the step (h) of reading from and/or writing to the tag by transmitting signals from the transmitter.

21. (New) A method according to claim 20, further comprising the step of deactivating the tag after the reading and/or writing is completed.

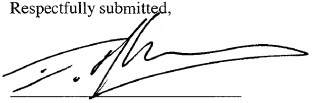
22. (New) A computer-readable memory having series of computer executable instructions for executing the method steps of the method of claim 18.

23. (New) A computer-readable memory having a series of computer executable instructions for executing the method steps of the method of claim 10.

REMARKS

Please enter the above amendment pertaining to the subject application. The foregoing amendment is intended to remove the multiple claims so as to place the claims in proper form, and to conform to the scope that the applicants believe they are entitled to under U.S. law. It is submitted that no new matter has been added as a result of this amendment.

Respectfully submitted,



Date: December 18, 2000

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02497/00102 139342.1

ANTI-COLLISION TAG APPARATUS AND SYSTEM

The present invention relates to radio frequency identification (RFID) apparatus comprising a reader/writer (later referred to as a 'reader') and transponders (tags).

Such apparatus forms the basis of a radio frequency tagging system, where the number of tags within the field that may be read is limited only by the number of unique combinations of bits used to define a code to identify each tag. Alternatively, two or more tags may define a set with the same combination or part combination of bits and these may be selected simultaneously. Such may be the case when deliberately sending data to tags of the same combination or part combination for the purposes of writing to them or disabling them or otherwise addressing them to modify their functionality.

In operation, an RFID reader will attempt to communicate with one or more RFID tags within the reader's transmission area. The reader transmits a predetermined signal (hereafter referred to as a "field") and then monitors the signal. The tags responding to the signal modulate it in a predetermined manner which is identified by the reader. However, if there are a number of tags within the transmission area it is difficult and time consuming to identify individual tags, communicate with only one tag and even to decrypt their responses to the transmitted signal.

Previous systems have mostly tried to achieve anti-collision of the signals modulated by the tags by incorporating some means to 'talk' to single tags, for example, by binary selection, sometimes by using randomness and helped by the slightly differing times that the tags are introduced into the area, or by beaming (directional control) of the field or by modification

of the field or alternatively by use of complicated algorithms to decrypt overlay data.

These systems are typically hindered by more than one tag 'talking' at the same time.

In the past systems have attempted to decrypt overlaying data caused by multiple tags 'talking' at the same time or have relied on random transmissions to separate signals in the time domain or have used a field beam or conduct a time consuming binary search to isolate individual tags. Often tags need to be read twice or even 3 times to confirm there has been no data error.

Such a system is disclosed in European patent application number 95112673.9. A tree splitting algorithm is used to identify a tag in a field. Where all tags respond simultaneously, they interfere with each others transmission and the base station receives corrupted data. The tree splitting algorithm organizes and sequences the transmission from tags via a random number generator so that the base station receives data in an orderly manner that is not superimposed and therefore corrupted.

According to an aspect of the invention, there is provided a radio frequency tag apparatus comprising a plurality of tags and a transceiver for sending information to, and simultaneously receiving information from, a plurality of tags without corruption, wherein each tag is allocated an identification word comprising a predetermined number of bits, the tags comprising means for selectively modulating a signal received from the transceiver, and the transceiver comprising means for sending an interrogation signal comprising a plurality of portions, wherein each portion is associated with a predetermined bit, or bit sequence, of the identification words

used to simultaneously interrogate, substantially at the same time, the tags to identify, in response to modulated signals provided by the tags, the presence of a tag or tags having a given value at the predetermined bit or bit sequence.

According to another aspect of the present invention, there is provided a method of detecting the presence of tags within a target area by sending interrogation signals from a transceiver for selective simultaneous modulation by tags present in the target area, each tag being allocated an

identification word comprising a predetermined number of bits, the method comprising:

sending from a transceiver an interrogation signal comprising a plurality of portions, each portion being associated with a predetermined bit or bit sequence of the identification words and being capable of conveying a given value for the bit or sequence of bits, wherein tags having the value at the predetermined bit or bit sequence are configured to modulate the signal, the modulation being used to identify the presence of those tags.

According to a further aspect of the present invention, there is provided a radio frequency tag identification system comprising a receiver/transmitter and transponders which are adapted to start communication at the same time and to be simultaneously interrogated and progressively eliminated from interrogation.

The present invention is directed to an alternative way of interactively isolating tags in a way that is highly efficient and very fast.

Operation is such that two or more transponders are capable of operating simultaneously in the same field in such a manner that information in the form of data bits may be received or sent to the tags without corruption. This has come to be known as anti-collision.

In contrast to previous systems, the present invention will not work unless the tags are allowed to 'talk' at the same time and uses positively 'collision' rather than trying to avoid it.

Moreover, the system of the present invention described is self-checking. Not only does the

reader check the tag output but the tag also checks the reader output, and will drop out in the case of an error. This self check means the tag need only be read once and is secure.

The invention will now be described by way of example only, with reference to accompanying figures:

Figure 1 is a data bit stream for use in an apparastus in accordance with the invention;
Figure 2 is another data bit stream for use in an apparatus in accordance with the invention;
Figure 3 is another data bit stream for use in an apparatus in accordance with the invention;
Figure 4 is a block diagram of an RFID 'reader' for use in an apparatus in accordance with the invention; and
Figure 5 is a block diagram of an RFID 'tag' for use in an apparatus in accordance with the invention.

In an embodiment of the invention all active tags are requested to start communicating at the same time, forming a 'collision' and are simultaneously interrogated and progressively eliminated. Communications from the tags are synchronised by, in this case, a search pattern, but this may be by any other form of synchronisation. Tags that do not receive a valid search pattern do not send data at all.

The invention might be better thought of as Synchronised Collision. It is normal for a reader to communicate to the tag using 100% modulation of the field. To start a search pattern, the reader transmits a data pattern called a 'Start Search Pattern'. This is understood by all tags as a start search command. There is another pattern known as a 'New Sweep Pattern' which

signals a new sweep within the overall search. Each sweep represents a single interrogation of the tags winthin reach and a number of sweeps equal to the number of tags plus one are needed to identify the presence of each individual tag. A search will generally consist of as many sweeps as there are tags in the field and an additional final sweep that may be aborted when no tags respond. The above "start search" and "new sweep" patterns in this example are detected by their duration but may be any compatible distinguishable pattern.

Tags are only allowed to participate in a search if they have received a 'Start Search Pattern'. This among other things, prevents late arrivals from disrupting the search. After the valid reception of a start search pattern, the tag is said to go active. The reader next transmits the interrogation pulse sequence. In this embodiment, the length of the pulse determines the binary value of the interrogation pulse, but alternative encoding schemes such as pulse code modulation may be used. The tag employs amplitude modulation, however, alternative methods such as phase shift keying may be used.

A 'search' will consist of a number of 'sweeps'. Each sweep will select an individual tag or set of tags sharing the same address. A normal sequence of a search of tags of different addresses will be shown below. Three states are referred to. These are 'Active' in which case the tag will participate in the search. 'Quiescent' in which case the tag is waiting for another sweep, and 'Inactive' in which case the tag has either not received a 'Start New Search' pattern or has already participated in a search and been eliminated (written to and/or read).

The sequence of steps for identifying tags in a field is as follows;

(a) A 'Start Search Pattern' is transmitted by the reader to alert all tags in the field that a search is to follow:- all tags in range go 'active'.

(b) A sequence of interrogation pulses (portions) corresponding to the number of bits, or sequences of bits, of the tag identification word, or else a reduced number if a set is to be identified, is sent out by the reader to which active tags interactively respond and all but 1 tag (or a set of tags sharing an identical address) is eventually eliminated. Data may be written to any tag/tags selected. Any tag so selected will then go inactive until the next 'Start Search Pattern'. Tags failing to be selected on a bit by bit (or bit pattern by bit pattern) basis go quiescent the moment they fail such an interrogation.

(c) A 'New Sweep Pattern' is transmitted by the reader – all tags in the quiescent state go active again. Tags that have not received a 'Start Search Pattern' or have already been selected (read) remain inactive.

(d) The reader loops back to 'b' above. At n +1 loops the reader detects no further tag interaction and ends the current search.

After transmission of a 'Start Search Pattern' the reader sends out a pulse. As the pulse duration increases, it passes through a period in time named the 0 modulation window (MW-0) in which all active tags which have a 0 in the first bit position must reply by turning on their modulator thus modulating the field. In the absence of a detectable response the reader will continue the duration of the pulse. As the pulse duration increases it passes through another period named the 1 modulation window (MW-1) in which all active tags which have a 1 in the first bit position must reply by turning on their modulator thus modulating the field. (Later it will be explained how bit patterns (such as 00,01,10,11) can be substituted for the individual bits.)

An example of a start search pattern followed by the transmission of three MW-0 windows, as transmitted by a reader, is shown in Figure 1.

In this embodiment, a tag will always be asked if its next bit is a 0 before it is asked if its next bit is a 1. Where more than one tag replies by modulating the field at the same time, the modulation of the field is increased. Logic within the reader will normally, upon the detection of modulation appearing in a MW-0 window, not extend the pulse to transmit a MW-1 modulation window. Where the MW-1 modulation window is not transmitted, any active tag that has a 1 in that position is programmed to go quiescent until a 'New Sweep Pattern' is received. In the instance that no active tag has a '0' in this position, the reader will extend the pulse up to the '1' position and all the active tags with a '1' in this position will remain active. The gap between the reader pulses is used by the tag to sequence the progress through the bits. The reader transmits the next interrogation pulse and so on. In this way the reader can conduct a highly efficient binary elimination, such that it needs only a 'Start Search Pattern' or a 'New Search Pattern' followed by as many pulses as there are bits in the tag type.

In this embodiment no distinction is made between tag data and the tag address. Tag data, if present, may be placed at the end of a tag address or alternatively in addressable blocks. Once a single tag has been isolated, the same process could be repeated to read any tag data, if present, however once the possibility of collisions has been eliminated, tag data can then be read in a more conventional way such as Manchester encoding or Phase shift modulation. The key point in this invention is the self checking 'anti-collision' method of isolating a single tag (or set of tags of the same address or part address) by the method described.

A tag may receive a start search pattern or a new sweep pattern and participate yet be out of the read range of the reader. In this instance the tag itself detects an apparent inconsistency in the reader transmissions. For example a tag which has just modulated a 0 window will expect the pulse to terminate instead of going on to the 1 modulation window. In this case the tag will go quiescent and wait for a new sweep pattern. This is a self-check and is a system advantage.

When a single tag or set of tags has been successfully isolated and identified, the reader may also write data to it (assuming the tag has EEROM or EPROM). Once read, the tag may be pre-programmed to remain silent until either the field is removed or it receives a new 'Start Search Pattern'. The reader will usually next transmit a 'New Sweep Pattern' and continue reading and eliminating tags until none remain. The 'New Sweep Pattern' wakes any tag in the 'quiescent state' that has been eliminated, but not read, from a previous sweep, allowing it to participate in the next sweep. Each sweep will normally identify a unique tag hence there will usually be as many sweeps as there are tags in the field, and a last sweep that will produce no results and may be aborted early.

The reader begins by sending a search pattern. The reader next starts to transmit a pulse. If no tag modulates the 0 window of the pulse, the reader will deduce that there is no active tag in the field that has a 0 in the first bit position. In this case the reader would continue the pulse to include a 1 modulation window. Any tag in the field with a 1 in this position will start modulating in this window and will continue to be active. In the instance of the first bit, if neither window is modulated the reader will deduce that there is no tag in range.

Assuming the first bit is modulated in the 0 modulation window (MW-0) and the reader stopped the pulse before the 1 modulation window, any tag with a 1 in this position will go quiescent until either a 'New Sweep Pattern' or a 'Start Search Pattern' is received. The reader continues onto the second bit and so on until it gets to the last bit position and an individual tag (or set of tags) has been isolated. After a tag has been identified and eliminated the reader will start a new sweep. (The significance of mentioning a 'set of tags' lay in the possibility that a special set of tags can be switched off, or if the facility allows, be written to, or otherwise made to perform in a special way. A further type of reader modulation may be inserted – say by a pulse extending beyond the 1 modulation window or an extra mini pulse - to let the set know it has been selected.)

In this fashion the reader will detect a 64 bit tag every 64 bit pulses (not including the 'Start Search Pattern and the 'New Sweep Patterns'). This is a highly efficient algorithm.

Figures 2 and 3 show a received signal at the reader, in response to a signal transmitted by the reader and modulated by tags.

Referring to Figure 2, it will be seen that pulses A, B and C have all been modulated in the '0' modulation window (MW-0). This is represented by the fall in the signal level following the MW-0 signal. This shows that there is at least one active tag in the field having a '0' in the first three bit positions. The 'Start Search Pattern in fig 1 is shown as a long pulse by example. In practice a long break in the field is more usual. This resets all tags.

In Figure 3, it will be seen that the first pulse (A) has been modulated by at least one tag

which has a '0' in the first position. The second interrogating pulse (B) shows that no active tags have a '0' bit in this position. As a consequence the reader has continued the pulse to allow active tags with a '1' in this position to respond and modulate the '1' modulation window and stay active. In this way tags are progressively read and eliminated.

In this embodiment modulation of the field by the tags is amplitude modulated (ASK) but phase modulation (PSK), frequency modulation (FSK) or any detectable form of modulation may be employed.

In this embodiment individual bits have been interrogated for simplicity, although bit patterns can be interrogated such as 00, 01, 10 or 11 and so on. In the instance of the following bit patterns, 00,01,10,11 this can be achieved by using 4 possible modulation windows representing the 4 possible combinations. The operation will be then carried out as before. The first modulation window could be 00. Any active tags having this bit pattern at this stage of the prosecution of the interrogation will be required to modulate this window and remain active. This will eliminate tags having bit patterns 01,10 and 11. Should no tags have a 00 pattern then the reader will extend the pulse to include the next modulation window and so on as in the case of detecting '0' and '1' bits. Because the reader need not modulate the field as many times, there is some speed advantage. As the bit pattern is increased beyond 2-3 bits it will be increasingly more difficult extract a speed advantage and if the bit pattern is made still larger the overall speed will eventually diminish.

Figures 4 and 5 are block diagrams of conventional apparatus configured for use in the present invention.

Claims

1. A radio frequency tag identification system comprising a plurality of tags and a transceiver for sending information to and simultaneously receiving information from a plurality of tags without corruption, wherein each tag is allocated an identification word comprising a predetermined number of bits, the tags comprising means for selectively modulating a signal received from the transceiver, and the transceiver comprising means for sending an interrogation signal comprising a plurality of portions, wherein each portion is associated with a predetermined bit, or bit sequence, of the identification words and is used to simultaneously interrogate tags and simultaneously receive information from tags to identify, in response to modulated signals provided by the tags, the presence of a tag or tags having a given value at the bit or bit sequence.

2. A system as claimed in claim 1, the transceiver further comprising, an antennae array, a radio frequency transponder, an external data communication port and an energizing source.

3. A system as claimed in claim 2, the transceiver being capable of generating modulated radio frequency power for application to the antennae.

4. A system as claimed in any one of the preceding claims, including in each tag an inductive loop antennae or capacitor plates that will convert the electric power into an electric field to communicate with transponders and provide the power for transponders where this power is not derived internally within the transponder from internal batteries or a light cell.

5. A system as claimed in any one of the preceding claims, including in each tag an antenna that will convert the signal power from the transceiver into an RF field to communicate with transponders.

6. A system as claimed in any one of the preceding claims, the transceiver including means for determining the nature of the modulation based on the logical outcome of previous communications with tags to conduct a binary search.

7. A system as claimed in any one of the preceding claims, the transceiver including means for detecting the modulation impressed on the field by any tag or plurality of tags in simultaneous communication, without corruption, comprising a demodulator and an amplifier, wherein the modulation signal is sent to a processor in a logic block and is digitized within a logic processor and evaluated.

8. A system as claimed in any one of the preceding claims, the tag or tags comprising signal pickup means, a rectifier, a limiter with hysteresis, a clock extractor, a data extractor, a modulator and a logic section.

9. A system as claimed in claim 8, in which the signal pickup means comprises a pickup coil.

10. A method of detecting the presence of tags within a target area by sending interrogarion signals from a transceiver for selective simultaneous modulation by active tags present in the target area, each tag being allocared an identification word comprising a predetermined number of bits, the method comprising:
sending from a transceiver an interrogation signal comprising a plurality of portions, each portion being associated with predetermined bit or bit sequence of the identification words and being capable of conveying a given value for the bit or sequence of bits, each portion being determined by the transceiver in dependence on the modulation response to the previous portion, wherein all tags in the field having the value at the predetermined bit or bit sequence are configured to simultaneously modulate the signal, the modulation being used to identify the presence of those tags.

11. A method as claimed in claim 10, wherein the presence of a tag or tags having an individual identification word is detected by sending an interrogation signal having portions and corresponding to all bits of the identification words.

12. A method as claimed in claim 10 or 11, using an adaptive interrogation signal wherein each portion comprises a first part which is used to simultaneously interrogate all active tags to determine whether the associated bit or sequence of bits has a first value, and a second part which is determined in dependence on the simultaneous response of the active tags in the field to interrogate the tags to determine whether the associated bit or sequence of bits has a second value.

13. A method as claimed in claim 12, wherein if a portion is used to interrogate the tags to determine whether the associated bit or sequence of bits having the first value, the first part is sent, and if the portion is used to interrogate the tags to determine whether the associated bit or sequence of bits has a second value, the first and second parts are sent.

14. A method as claimed in claim 10 to 13, wherein a tag not having the value at the predetermined bit or bit sequence ignores further signals until an activation or a wake signal is received.

15. A method as claimed in any one of claims 10 to 14, wherein data bits of a tag transponder are read from and/or written to by sending further bits after the interrogation signal, wherein tag then deactivates and ignores further signals until an activation signal is received.

16. A method whereby a tag can determine if the reader transceiver has received its attempted communication based on subsequent interrogation signals.

1/2

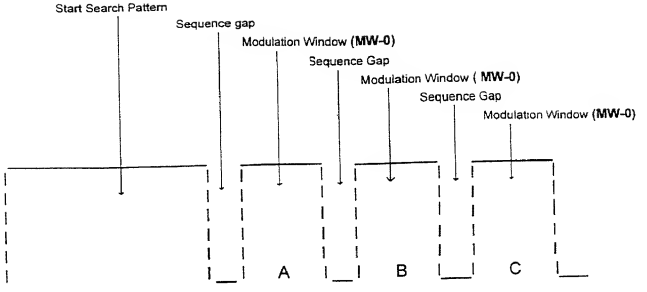
Start Search Pattern
Sequence gap
Modulation Window (MW-0)
Sequence Gap
Modulation Window (MW-0)
Sequence Gap
Modulation Window (MW-0)
A
B
C

Fig 1

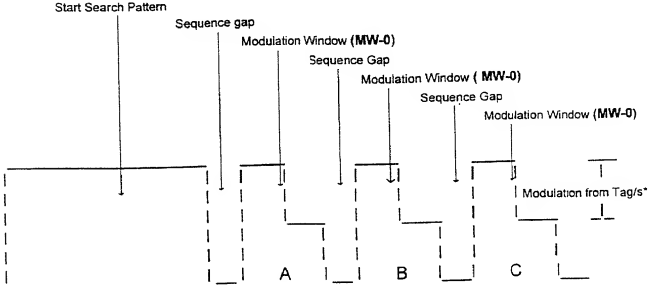
Start Search Pattern
Sequence gap
Modulation Window (MW-0)
Sequence Gap
Modulation Window (MW-0)
Sequence Gap
Modulation Window (MW-0)
Modulation from Tag/s"
A
B
C

Fig. 2

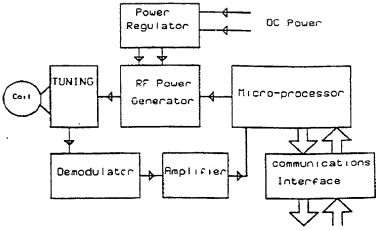

Fig 4

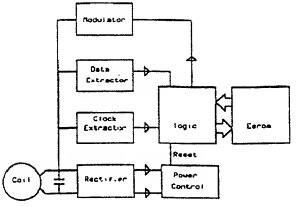

Fig 5

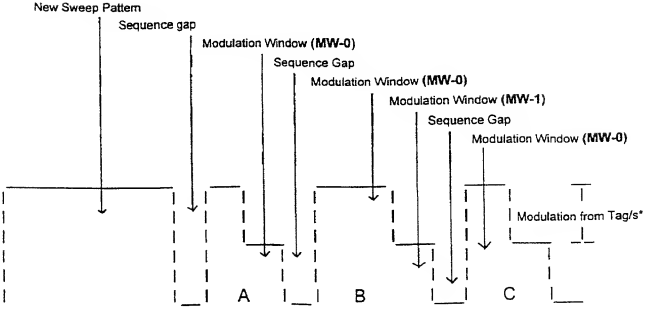

Fig 3

*Note. The amount of modulation from tags is exaggerated. Typical modulation may be too small to be shown.

Docket No.
2497/102

Declaration and Power of Attorney For Patent Application

English Language Declaration

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

ANTI-COLLISION TAG APPARATUS AND SYSTEM

the specification of which

(check one)

☐ is attached hereto.

☒ was filed on **June 22, 1999** as United States Application No. or PCT International Application Number **PCT/GB99/01964 (US. Serial Number 09/719,958)**

and was amended on **December 18, 2000**

(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)			Priority Not Claimed
98 133 71.3	**GB**	**22/06/98**	☐
(Number)	(Country)	(Day/Month/Year Filed)	
			☐
(Number)	(Country)	(Day/Month/Year Filed)	
			☐
(Number)	(Country)	(Day/Month/Year Filed)	

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

(Application Serial No.)	(Filing Date)
(Application Serial No.)	(Filing Date)
(Application Serial No.)	(Filing Date)

I hereby claim the benefit under 35 U. S. C. Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C. F. R., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. *(list name and registration number)*

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Int'l Application No:	PCT/GB99/01964
Int'l Filing Date:	22 June 1999
Title of Invention:	Anti-Collision Tag Apparatus and System
Atty Docket:	2497/102

Commissioner for Patents
BOX PCT
Washington, DC 20231
Attn: EO/US

REQUEST FOR CHANGE OF ADDRESS OF INVENTOR

Applicant requests the change of address of the below named Inventor be entered for the above-referenced application as follows:

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